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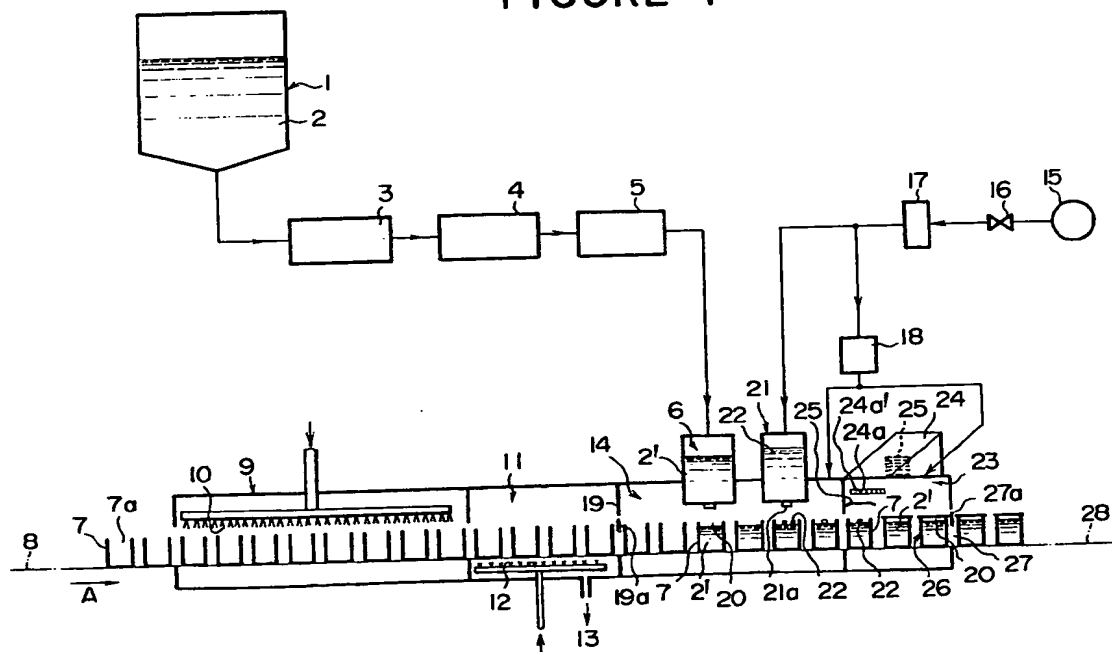
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(54) Method and apparatus for making a hermetically sealed food container

(57) A sterilized container body is filled with sterilized food under an aseptic

inert gas atmosphere, while a prescribed headspace is left in the container body adjacent to the top thereof. The container body is hermetically closed by a sterilized lid. Aseptic liquid nitrogen is supplied into the container body before it is closed, or an aseptic inert gas is dissolved under pressure in the sterilized food before the container body is filled with the food, whereby, a positive pressure, which is higher than atmospheric pressure, is maintained in the hermetically sealed container. The container is not easily deformed, even if it has a thin wall, and can preserve food for a long time at ordinary room temperature. Food from tank 1 is sterilized by heater 3, cooled by cooler 5 and added to cans 7 which has been sterilized in chamber 10 and cooled in chamber 11. Aseptic nitrogen is supplied to filled cans by nozzle 21a and lids 25 sterilized in chamber 24 are applied to the cans in chamber 23 under nitrogen supplied via curtain 24a'.

FIGURE 1



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FIGURE 1

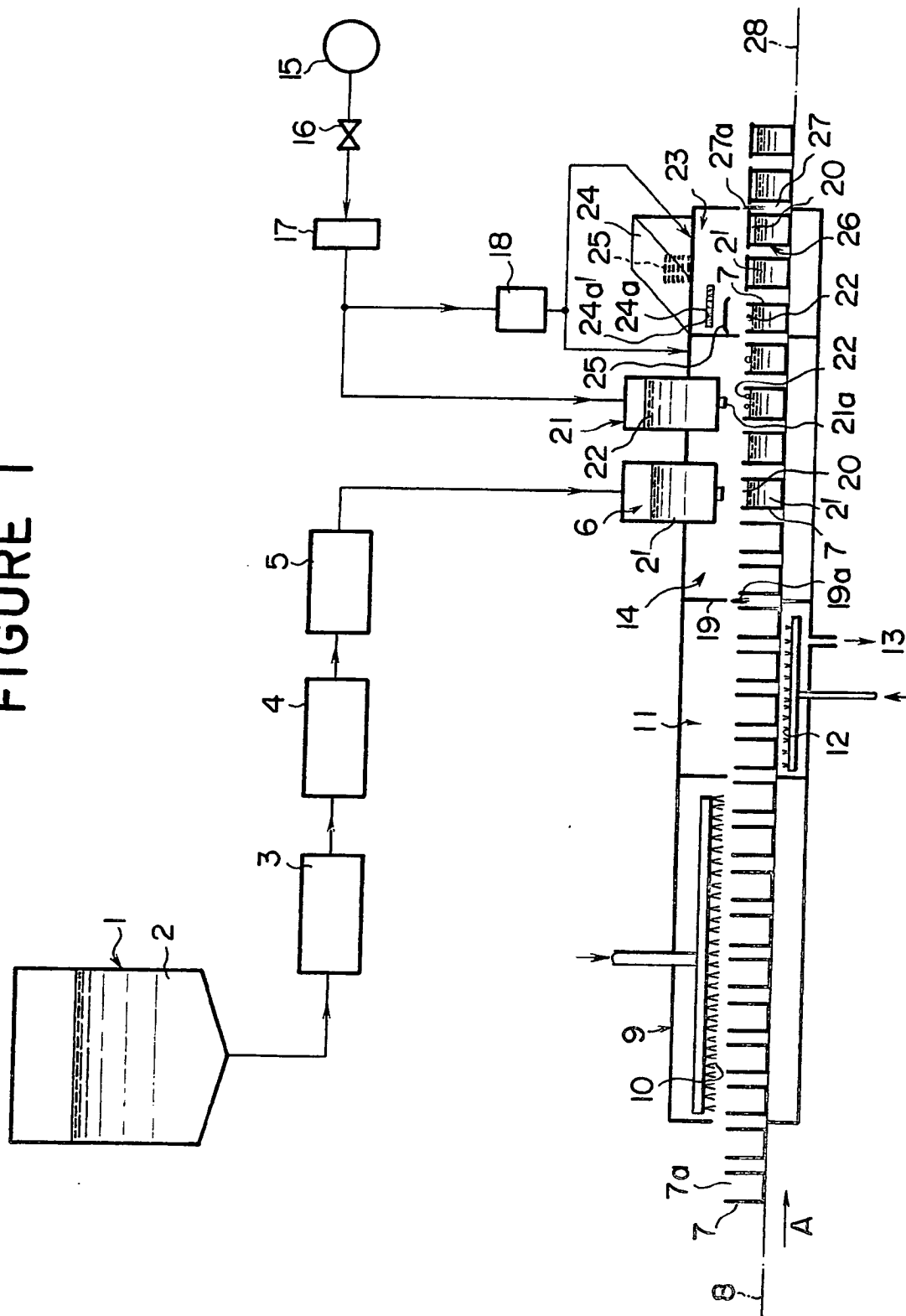
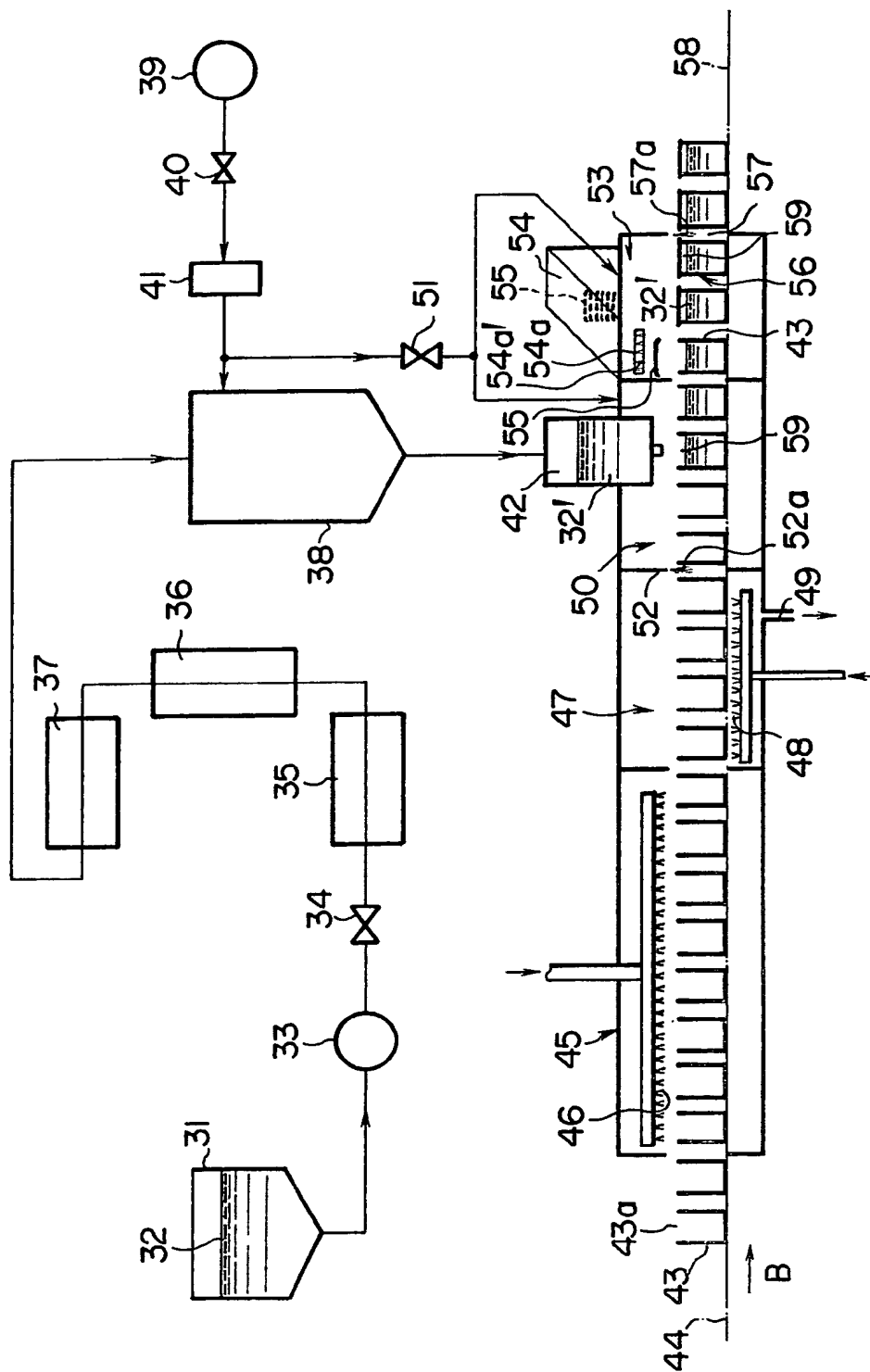


FIGURE 2



SPECIFICATION

Method of making a hermetically sealed food container

- 5 This invention relates to a method of making a hermetically sealed food container. More particularly, it is concerned with a method of making a hermetically sealed food container wherein a food is placed into a container body and sealed in an aseptic condition, so that the container may maintain a slight positive pressure, or a pressure which is slightly higher than normal atmospheric pressure, thereby not to easily collapse or be susceptible to permanent deformation. 5
- 10 If a self-shape retaining container having a relatively thin and flexible wall which can be easily depressed by a finger is filled with food of low acidity, and hermetically sealed by an ordinary method employing steam displacement or evacuation, it is likely to get depressed or permanently deformed, and lose its commercial value, since a negative pressure prevails in the interior of the container at ordinary room temperature. Such a container may, for example, be a draw-ironed can or a welded can of tinfoil, or aluminum or an alloy 10
- 15 thereof having a wall thickness of, say, 0.05 to 0.17 mm, or a cup-shaped container formed by drawing a laminate comprising a plastic film and a metal foil. The term "food of low acidity" as herein used refers to food having a pH value of about 4.5 or above, and which requires sterilization after hermetical closure of its container in order to withstand a long time of preservation at ordinary room temperature. Examples of such food include drinks or liquid food such as coffee, tea, cocoa, milkshake, soup and cream, plain boiled or 15
- 20 seasoned vegetables such as asparagus or sliced vegetables picked in soy sauce, and plain boiled, oil-preserved or seasoned fish, shellfish or meat. It has, therefore, been proposed to close the container after placing liquid nitrogen thereinto, or in the case of liquid food, to dissolve nitrogen gas in the food having a low temperature of, say, 0°C to 10°C under pressure before filling and closing the container, in order that a positive pressure may be maintained in the container at ordinary room temperature to prevent any 20
- 25 depression thereof. For the preservation of such food for a long time at ordinary room temperature, however, it is necessary to conduct retort sterilization or the like after closing the container, as already stated. If nitrogen exists in the container, however, the food has a lower thermal conductivity, and its perfect sterilization requires a longer time. This results in the food which is inferior in taste, flavor and color and the like. Moreover, the heat 30
- 30 treatment of food for sterilization or the like causes an increase in the internal pressure of the container having a positive internal pressure, resulting easily in the buckling of its bottom, or the breakage of its thin wall. In order to prevent any such trouble, it is necessary to keep strict control over the internal pressure of the container, and the heating conditions. In order to maintain the high quality of food, it is advisable to heat it at a high temperature of, say, 135°C for a short time of, say, one minute. This is, however, difficult to do for 35
- 35 a food container having a positive internal pressure. It is an object of this invention to provide a method of making a hermetically sealed food container, wherein even if the container has a relatively thin and flexible wall, it is not easily be depressed or permanently deformed.
- 40 It is another object of this invention to provide a method of making a hermetically sealed food container which can withstand a long time of preservation at ordinary room temperature without requiring any heat treatment for sterilization after the container has been closed. 40
- It is a further object of this invention to provide a method of making a hermetically sealed food container so that the food may retain its excellent taste, flavor, color or other property.
- 45 According to this invention, there is provided a method of making a hermetically sealed food container which comprises sterilizing a food, sterilizing a container body, placing said sterilized food and an aseptic gas-forming substance into said sterilized container body, under an aseptic inert gas atmosphere, while a headspace portion is formed above the sterilized food, sterilizing a lid, hermetically sealing said container body containing said sterilized food by means of said sterilized lid, such that said headspace portion, after 45
- 50 hermetically sealing, contains an aseptic inert gas under pressure which pressure at room temperature is higher than the surrounding ambient atmospheric pressure outside the hermetically sealed food container, whereby said container has a long shelf life at room temperature and the wall portion of said container body is not susceptible to permanent deformation. 50
- The gas-forming substance can comprise aseptic liquid nitrogen which is placed into the sterilized container body containing the sterilized food, under an aseptic inert gas atmosphere before hermetically 55
- 55 sealing. In case where the food is a liquid food, the sterilized food can be cooled to a low temperature before placing into the container body and an aseptic inert gas can be dissolved, under pressure, into the cooled sterilized food, thereby to form a gas-forming substance.
- The invention will now be illustrated by the following detailed description and accompanying drawings in which:-
- 60 *Figure 1* is a diagrammatic view illustrating a first embodiment of apparatus in accordance with the invention which may be employed for carrying out the method of this invention; and 60
- Figure 2* is a view similar to *Figure 1*, but showing a second embodiment of apparatus in accordance with the invention for carrying out the method of this invention.
- Referring to *Figure 1* of the drawings, food 2 is supplied from a tank 1 to a heater 3, or a heat exchanger if 65
- 65 the food is a liquid, and heated to a prescribed sterilizing temperature. The food 2 is transferred to a heat 65

holder 4, and held at the sterilizing temperature for a prescribed length of time, whereby it is sterilized. The food 2 is then, cooled in a cooler 5 to at least a temperature at which not a large quantity of steam is generated. For sterilization, it is desirable to heat the food at a high temperature of, say, 130°C to 150°C for only a short time of, say 0.5 to three minutes, depending on the kind of food, in order to prevent degradation of the food in taste, flavor or color and the like.

The sterilized food 2' is transferred to a sterilized filling device 6.

A plurality of container bodies 7, for example, draw-ironed cans or welded cans, each having an open top 7a are continuously furnished on a conveyor 8 in the direction of an arrow A, and heated to a temperature of, say, 220°C to 225°C in a high temperature sterilizing chamber 9 in which superheated steam 10 having a temperature of about 300°C is sprayed against the container bodies 7, whereby all the bacteria and spores adhering to the surfaces of the container bodies 7 are completely killed. In case where the food 2' has a low pH value, the container bodies 7 are heated to about 120°C to 140°C, and it is sufficient to use steam having a lower temperature of, say, 150°C to 200°C. The container bodies 7 are cooled in a cooling chamber 11 where sterile cooling water 12 is sprayed upwardly against the container bodies 7. The cooling water is discharged through a drain 13. The container bodies 7 are, then, transferred into a filling chamber 14 into which aseptic nitrogen gas is introduced from a liquid nitrogen tank 15 through a pressure reducing valve 16, an aseptic treating filter, or other aseptic treating device 17 and a gasifying device 18. The filling chamber 14 is separated from the cooling chamber 11 by a partition 19 except for a passage for the container bodies 7. This passage is preferably provided with a gas curtain 19a which may be formed by aseptic nitrogen gas. The partition 19 and the gas curtain 19a are provided for preventing steam from leaking from the cooling chamber 11 into the filling chamber 14, and entering the container bodies 7. When each container body 7 has arrived at a position directly below the filling device 6, it is filled with a prescribed quantity of sterilized food 2', while a prescribed headspace 20 is left adjacent to the top of the container body 7.

Provided downstream of the filling device 6 is a liquid nitrogen injecting device 21 into which aseptic liquid nitrogen 22 (that is, a gas-forming substance) is supplied through the aseptic treating device 17. When each container body 7 has arrived at a position directly below the liquid nitrogen injecting device 21, a prescribed quantity of aseptic liquid nitrogen 22 is injected therein through a nozzle 21a so that a prescribed amount of pressure may be maintained in the container. The liquid nitrogen may be dropped, flowed or jetted down into the container. The liquid nitrogen 22 floats in drops on the surface of the food 2', and immediately begins to vaporize.

Each container body 7 is, then, fed into a sealing chamber 23 in which an aseptic nitrogen gas atmosphere is maintained by aseptic nitrogen gas supplied through the gasifying device 18. A superheated steam sterilizing chamber 24 for lids 25 is provided adjacent to the sealing chamber 23, and supplies the lids 25 one by one into the sealing chamber 23 through a slit 24a. The slit 24a is provided with an aseptic nitrogen gas curtain 24a' for preventing steam from entering the sealing chamber 23. The sealing chamber 23 has an outlet 27 for a hermetically sealed container 26, and the outlet 27 is provided with an aseptic nitrogen gas curtain 27a for preventing infiltration of air into the sealing chamber 23. If any steam enters the headspace 20 in the sealed container 26, it condenses and acts to lower the internal pressure of the container, thereby making it difficult to maintain a prescribed internal pressure which is desirably as low as possible while nevertheless resisting any depression of the wall or other portion of the container. If air enters the headspace 20, it is likely that the food may no longer be aseptic, or that the oxygen in the air may cause degradation of the food, or promote dissolution of metal from the container. Each container body 7 holding the food 2' and the aseptic liquid nitrogen 22 is immediately closed by a lid 25 by a closing device not shown, e.g. a double-seaming machine, whereby a hermetically sealed container 26 holding food therein is prepared. The container 26 leaves the sealing chamber 23 through its outlet 27, and is transferred by a conveyor 28 to the next process. Gasified nitrogen in the container 26 maintains a pressure of, say, 0.3 to 2.0 kg/cm² (gauge pressure) therein at ordinary room temperature, e.g. at 20°C.

Instead of nitrogen, any other inert gas, such as aseptic argon, may be used for introduction into the filling chamber 14 and the sealing chamber 23. While the method of this invention is particularly suitable for food of low acidity, it is equally applicable to food of medium or high acidity.

Referring now to Figure 2, there is shown another embodiment of this invention that is particularly applicable to liquid food. The term "liquid food" as herein used refers to one consisting of only liquid as well as one containing some amount of solid particles. Food 32 is supplied from a tank 31 to a heat exchange 35 through a pump 33 and a flow control valve 34, and heated to a prescribed temperature t_1 of, say, 90°C to 150°C. The food 32 is completely sterilized at the prescribed temperature t_1 in a heat holder 36, and cooled to a low temperature t_2 in a cooling heat exchanger 37. By using the above device the heat treatment of the food can be performed under the conditions which best suit its properties. It is known best to heat food at a high temperature for a short time. A high temperature can be employed, since the food 32 passing through thin tubes in the heat exchangers 35 and 37, and the heat holder 36 has a high thermal conductivity. A drastically short heating time of, say, one second to two minutes is sufficient for perfect sterilization, as opposed to the prior art in which food is heated for sterilization after its container has been closed. Accordingly, it is possible to minimize any possibility of food degradation due to its heat treatment for sterilization.

The food 32, which has been cooled to the low temperature t_2 , is delivered into a gas dissolving chamber 38 in which an aseptic inert gas having a gauge pressure of, say, 4 kg/cm² is dissolved in the food 32. This

aseptic inert gas is supplied from a high pressure inert gas tank 39 through a pressure reducing and flow control valve 40 and an aseptic treating device 41, such as an aseptic treating filter, or a high temperature heating and cooling device. The inert gas may be selected from among, for example, nitrogen, argon, carbon dioxide, and a mixture thereof. Nitrogen is most preferable, since it is inexpensive, and hardly has any adverse effect on the taste or flavor of food. If carbon dioxide is employed, it is necessary to limit its quantity to the extent that does not cause any foaming, or change in the taste or flavor and the like of food. The gas can be better dissolved at a low temperature. Accordingly, the aforesaid low temperature t_2 is preferably in the range between the minimum temperature at which the food can stay in liquid state, and about 10°C, or more preferably about 5. For some food, the aforesaid minimum temperature may be lower than 0°C. The gas dissolving chamber 38 may duplicate a known carbonator of, for example, the spray type, stirring type, spray and stirring type, or thin film flow type. The food 32 usually remains in contact with the inert gas for several seconds. The food 32' carrying dissolved inert gas (that is, a gas-forming substance) therein is delivered into a filling device 42, and maintained substantially at the low temperature t_2 .

A plurality of container bodies 43, for example, draw-ironed cans or welded cans, each having an open top 43a are furnished on a conveyor 44 in the direction of an arrow B, and heated to a temperature of, say, 220°C to 225°C in a high temperature sterilizing chamber 45 in which superheated steam 46 having a temperature of about 300°C is sprayed against the containers 43, whereby all the bacteria and spores adhering to the surfaces of the containers 43 are completely killed. The containers 43 are, then, cooled to substantially ordinary room temperature in a cooling chamber 47 in which sterile cooling water 48 is sprayed upwardly against the containers 43. The cooling water is discharged through a drain 49. The container bodies 43 are, then, delivered into a filling chamber 50 into which aseptic inert gas is introduced through a pressure reducing valve 51. The filling chamber 50 is separated from the cooling chamber 47 by a partition 52 except for a passage for the container bodies 43, and this passage is preferably provided with an aseptic inert gas curtain 52a, so that no steam may flow from the cooling chamber 47 into the filling chamber 50. When each container body 43 has arrived at a position directly below the filling device 42, it is filled with a prescribed quantity of food 32', while a prescribed headspace 59 is left adjacent to the top of the container body 43.

The container body 43 is, then, delivered into a sealing chamber 53. A superheated steam sterilizing chamber 54 for lids 55 is provided adjacent to the sealing chamber 53, and supplies the lids 55 one by one into the sealing chamber 53 through a slit 54a. Aseptic inert gas is supplied into the sealing chamber 53 through the pressure reducing valve 51. The slit 54a is preferably provided with an aseptic inert gas curtain 54a' so that no steam may enter the filling chamber 53. The filling chamber 53 has an outlet 57 for a hermetically sealed container 56, and the outlet 57 is preferably provided with an aseptic inert gas curtain 57a for preventing infiltration of air into the filling chamber 53. If steam enters the headspace 59 in the hermetically sealed container 56, it condenses, and acts to lower the internal pressure of the container. If air enters the container, it is likely that the food therein may no longer be sterile, or that oxygen may cause degradation of food, or promote dissolution of metal from the container. Thus, each container 43 filled with the food 32' is hermetically closed by a lid 55 by a closing device not shown in the presence of an aseptic inert gas atmosphere. The container should preferably be closed within about two seconds after it has been filled with the food, so that the inert gas dissolved in the food may not escape. Each hermetically sealed container 56 leaves the sealing chamber 53 through its outlet 57, and is delivered to the next process by a conveyor 58. Each container 56 usually has an internal pressure of, say, 0.3 to 2.0 kg/cm² (gauge pressure) at ordinary room temperature, e.g. at 20°C.

A known method of filling and sealing food under an aseptic condition in a metallic can usually employs a filling chamber and a sealing chamber which are filled with semi-saturated steam. Accordingly, a hermetically sealed can has a considerably high degree of vacuum of, say, 50 cm Hg at ordinary room temperature. A draw-ironed can or a welded can having a thin and flexible wall easily gets depressed, and fails to provide a satisfactory product. According to this invention, however, the can is closed after it has been filled with a sterile food and an aseptic gas-forming substance under an aseptic inert gas atmosphere. The gas-forming substance such as an inert gas dissolved into the liquid food or liquid nitrogen vaporizes at ordinary room temperature of, say, 15°C to 30°C, and a positive pressure is developed in the can. In other words, the headspace of the can contains an inert gas whose pressure at room temperature is higher than the surrounding ambient atmospheric pressure outside the can. Accordingly, the can is had to get depressed, even if it has a thin and flexible wall. This advantageously makes it possible to reduce the cost of container manufacture.

According to this invention, the inert gas, the container body, the lid and the food are all sterilized before the container is closed. No pasteurization or retort sterilization, which requires a considerably long time, is required after the container has been closed. It is, therefore, possible to avoid any buckling of the bottom of the container, or breakage of its wall that would occur if a hermetically sealed container maintaining a positive pressure therein was subjected to, for example, retort sterilization. Moreover, it is possible to heat food at a high temperature for only a short time for sterilization before filling and closing the container, and thereby maintain the excellent taste, flavor and color or the like of food in a hermetically sealed container.

The invention will now be described with reference to examples.

Example 1

White coffee, or cafe au lait was heated from ordinary room temperature to 136°C by the heater 3 shown in Figure 1 (heat exchanger), and allowed to pass through the heat holder 4 at that temperature for 60 seconds. Then, the coffee was cooled to 25°C through the cooler 5 for 100 seconds, and delivered to the filling device 6 immediately.

A plurality of draw-ironed cans of tinplate each having a diameter of 53 mm, a height of 133 mm, an inwardly convex bottom wall thickness of 0.30 mm and a sidewall thickness of 0.11 mm were continuously furnished into the high temperature sterilizing chamber 9. Each can had an inner surface carrying a coated film of a phenol-epoxy resin having a thickness of 12 µm. Superheated steam having a temperature of 290°C was sprayed against the cans to sterilize them, and sterile cooling water was sprayed against the sterilized cans in the cooling chamber 11 to cool them to about 30°C. Each can was delivered into the filling chamber 14 provided with an aseptic nitrogen gas curtain shutting off steam, and filled with coffee by the filling device 6 in the presence of aseptic nitrogen gas to the extent that a headspace having a height of 7 mm was left adjacent to the top of can. Immediately thereafter, aseptic liquid nitrogen was dropped into the can by the liquid nitrogen injecting device 21 in a prescribed quantity which would maintain a gauge pressure of 1.3 kg/cm² in a hermetically sealed can at 20°C. Then, the can was fed into the sealing chamber provided with an aseptic nitrogen gas curtain shutting off air, and double-seamed by a sterilized lid 25 having a similarly coated inner surface.

The hermetically sealed can had an internal pressure of 1.3 kg/cm² (gauge pressure) at 20°C, and was never depressed in the sidewall at 20°C. The ten cans were allowed to stand at 37°C for six months, and when they were thereafter opened, the coffee therein did not show any sign of degradation.

Comparative flavor tests were conducted by opening cans immediately after white coffee had been sealed therein. White coffee not heated by the heater 3 was employed as a control. Three points were given to the coffee considered as being comparable to the control, two points to the coffee considered as being inferior, one point to the coffee considered as being inferior, and zero point to the coffee considered as being extremely inferior. The tests were conducted by a panel of ten members, and an average of the points was obtained. The results are shown in Table 1 below. Table 1 indicates that the coffee sealed by the method of this invention is substantially comparable to the control.

TABLE 1

*Average points given by a
panel for flavor tests*

Example 1 (invention)

2.8

Comparative Example 1

1.5

Comparative Example 2

1.8

Comparative Example 3

2.8

Comparative Example 4

2.9

Comparative Example 1

The same white coffee, or cafe au lait as used in Example 1 was hermetically sealed in the draw-ironed cans as used in Example 1, in a customary manner employing a vacuum of 53 cm Hg, and retorted at 125°C for 14 minutes. The can had a heavily depressed sidewall, and was of no commercial value. The coffee, however, showed no sign of degradation after storage under the same conditions as in Example 1. The coffee was tested for flavor as described in Example 1. The results are shown in Table 1 above.

Comparative Example 2

White coffee not preliminarily heated for sterilization was sealed in the open air after liquid nitrogen had been dropped therein, and retorted at 140°C for three minutes. Otherwise, the procedures of Example 1 were repeated, including the quantity of the liquid nitrogen employed. Buckling occurred to the bottom of the can during cooling after retorting. The results of the flavor test are shown in Table 1. The coffee was stored under the same conditions as in Example 1, and did not show any sign of degradation.

Comparative Example 3

The procedures of Example 1 were repeated, except that the filling chamber 14 and the sealing chamber 23 were not supplied with any aseptic nitrogen gas, but filled with saturated steam. The same quantity of aseptic liquid nitrogen as in Example 1 were employed. The hermetically sealed can showed a vacuum degree of 48 cm Hg, and was heavily depressed in the sidewall. The results of the flavor test were, however,

satisfactory as shown in Table 1, and the coffee did not show any sign of degradation after storage under the same conditions as in Example 1.

Comparative Example 4

- 5 The procedures of Example 1 were repeated, except that the nitrogen gas, the can and the lid were not sterilized. The sealed can was not depressed in the sidewall, and the results of the flavor test which was conducted as described in Example 1, were satisfactory as shown in Table 1. In all the cans, however, coffee showed degradation after storage under the same conditions as in Example 1. 5

10 *Example 2*

White coffee, or cafe au lait was heated from ordinary room temperature to 136°C by the heat exchanger 35 shown in Figure 2, and allowed to pass through the heat holder 36 so that temperature for 60 seconds. Then, the coffee was cooled to 3°C for 120 seconds through the cooling heat exchanger 37. The coffee was, then, fed into a thin film type gas dissolving chamber, and contacted with aseptic nitrogen gas at 4 atm. for 60 seconds, whereby the nitrogen gas was dissolved in the coffee. The coffee was delivered into the filling device 42 in which it was maintained at a temperature of 4°C. 10 15

- A plurality of draw-ironed cans of tinplate each having a diameter of 53 mm, a height of 133 mm and a sidewall thickness of 0.11 mm were continuously furnished into the high temperature sterilizing chamber 45. Each can had an inner surface carrying a coated film of a phenol-epoxy resin having a thickness of 12 µm. Superheated steam having a temperature of 290°C was sprayed against the cans for sterilizing them. Then, in the cooling chamber 47, sterile cooling water was sprayed against the cans for cooling them to about 30°C. The cans were, then, fed into the filling chamber 50 provided with an aseptic nitrogen gas curtain for shutting off steam, and filled with coffee under an aseptic nitrogen gas atmosphere, while a headspace having a height of 7 mm was left adjacent to the top of each can. Immediately thereafter, each can was fed into the sealing chamber 53 provided with an aseptic nitrogen gas curtain for shutting off air, and double-seamed by a sterilized lid having a similarly coated inner surface. 20 25

The hermetically sealed can had an internal pressure of 1.1 kg/cm² (gauge pressure) at 20°C, and was not deformed in the sidewall at 20°C. The ten cans were stored at 37°C for six months, and when they were then opened, the coffee therein did not show any sign of degradation.

- 30 Comparative flavor tests were conducted by opening cans immediately after coffee had been sealed therein. White coffee not heated by the heat exchanger 35 was used as a control. Three points were given to the coffee considered as being comparable to the control, two points to the coffee considered as being slightly inferior, one point to the coffee considered as being inferior, and zero point to the coffee considered as being extremely inferior. The tests were conducted by a panel of ten members, and the average points of the panel were obtained. The results are shown in Table 2 below. Table 2 indicates that the coffee sealed by the method of this invention is substantially comparable to the control. 35

TABLE 2

40			40
		<i>Average points given by a panel for flavor tests</i>	
	Example 2 (invention)	2.8	
45	Comparative Example 5	1.5	45
	Comparative Example 6	1.1	
50	Comparative Example 7	2.8	50
	Comparative Example 8	2.9	

55 *Comparative Example 5*

The white coffee as employed in Example 2 was sealed in the same draw-ironed cans as in Example 2, by a customary method employing a vacuum of 53 cm Hg, and retorted at 125°C for 14 minutes. The can was heavily depressed in the sidewall, and was of no commercial value. The coffee, however, did not show any sign of degradation after storage under the same conditions as in Example 2. The flavor test was conducted as set forth in Example 2, and the results thereof are shown in Table 2 above. 60

Comparative Example 6

- Unsterilized nitrogen gas was dissolved under pressure in white coffee not preliminarily heated for sterilization. The coffee was sealed in an unsterilized can of the type as used in Example 2, and the can was closed by a unsterilized lid, while unsterilized nitrogen gas was being sprayed thereagainst. Then, the coffee 65

was retorted at 125°C for 30 minutes. The can sidewall was not depressed. The results of the flavor test were, however, unsatisfactory as shown in Table 2. The coffee did not show any sign of degradation after storage under the same conditions as in Example 2.

5 *Comparative Example 7*

5

The procedures of Example 2 were repeated, except that the filling chamber 50 and the sealing chamber 53 were not supplied with any aseptic nitrogen gas, but filled with saturated steam. The hermetically sealed can showed a vacuum degree of 48 cm Hg, and was heavily depressed in the sidewall. The results of the flavor test were, however, satisfactory as shown in Table 2, and the coffee did not show any sign of degradation after storage under the same conditions as in Example 2.

10

Comparative Example 8

The procedures of Example 2 were repeated, except that the nitrogen gas, the cans and the lids were not sterilized. None of the sealed cans was depressed in the sidewall, and the results of the flavor test which was conducted as described in Example 2, were satisfactory as shown in Table 2. In all the cans, however, the coffee showed degradation after storage under the same conditions as in Example 2.

15

CLAIMS

- 20 1. A method of making a hermetically sealed food container which comprises filling a sterilized food into a sterilized food container under an aseptic atmosphere while leaving a headspace above the sterilized food and introducing an aseptic inert gas-forming substance into the container and thereafter sealing the container, whereby, after hermetically sealing the container, a superatmospheric inert gas pressure exists therein at normal room temperature so that the contents have an extended shelf life and the wall portion of the container maintains its shape during storage. 20
- 25 2. A method according to claim 1 wherein the inert gas-forming substance is introduced into the container after filling the container with food. 25
3. A method according to claim 1 wherein the inert gas-forming substance is mixed with the food prior to introduction into the container.
- 30 4. A method according to claim 3 wherein said food is a liquid food and said sterilized food is cooled before filling it into the container and an inert aseptic gas is dissolved, under pressure, in said sterilized food so as to form said gas-forming substance. 30
5. A method according to claim 4 wherein the food is cooled to a temperature in the range of 0°C to 10°C.
- 35 6. A method according to any one of the preceding claims wherein the inert gas-forming substance is aseptic liquid nitrogen and is introduced into the container under an aseptic inert gas atmosphere prior to sealing the container. 35
7. A method according to any one of the preceding claims wherein the container is a metal can and the lid is sterilized prior to sealing the container.
8. A method according to claim 7 wherein the can is a draw-ironed can or welded metal can having a sidewall thickness of 0.05 to 0.17 mm. 40
9. A method according to any one of the preceding claims wherein said superatmospheric pressure is 0.3 to 2 kg/cm² higher than the ambient pressure at 20°C.
10. A method of making a hermetically sealed food container which comprises:
 - sterilizing a food, sterilizing a container body, placing said sterilized food and an aseptic gas-forming substance into said sterilized container body, under an aseptic inert gas atmosphere, while a headspace portion is formed above the sterilized food, sterilizing a lid, hermetically sealing said container body containing said sterilized food by means of said sterilized lid, such that said headspace portion, after hermetically sealing, contains an aseptic inert gas under pressure which pressure at room temperature is higher than the surrounding ambient atmospheric pressure outside the hermetically sealed food container, whereby said container has a long shelf life at room temperature and the wall portion of said container body is not susceptible to permanent deformation. 45
- 50 11. A method according to any one of the preceding claims wherein the food has a pH value of at least 4.5. 50
12. A method of making a hermetically sealed food container substantially as described with reference to Examples 1 and 2. 55
13. Hermetically sealed food containers whenever produced by the method claimed in any one of the preceding claims.
14. Apparatus for packaging a food in a container under sterile conditions which comprises a container filling station having a vessel for holding sterilized food and having a filling mechanism for individually filling sterilized containers conveyed beneath said vessel and through a chamber filled with aseptic inert gas and means for hermetically sealing the containers after being filled with the sterilized food, said apparatus including means for introducing an aseptic inert gas-forming substance into the sterilized containers prior to sealing. 60

15. Apparatus according to claim 14 wherein the aseptic gas-forming substance is liquid nitrogen and the apparatus includes means for introducing it into the headspace of the containers after filling with sterilized food.

16. Apparatus according to claim 14 which includes means for introducing aseptic nitrogen under
5 pressure into the sterilized food prior to filling into the sterilized containers, whereby the nitrogen dissolves
in the food and forms a gas-forming substance.

5

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